# ELEMENT TWO: METHODOLOGY

## 2.1 INTRODUCTION

The purpose of this element is to identify and describe the process and methodology to recognize trends, and provide decision makers with information regarding the effects of varying levels of capital investment, or shifting emphasis, from one type of development to another. The selected methodology should be able to assess the level of system performance for the various funding levels, address the issues listed in the state's original request for proposal (RFP), be easily understandable by the Planning Advisory Committee (PAC), and concur with the goals and objectives of the Governor's Vision 21 Task Force for improving transportation systems across the state.

To adequately present the SANS methodology, this element is organized in the following manner:

- Definitions;
- Desired features for the SANS 2000 Methodology;
- Concept Selected for the SANS 2000;
- Performance Criteria and Measures;
- Performance Based Needs Scenarios; and
- Summary.

## 2.2 DEFINITIONS

The terminology being used for the SANS is based on operational definitions of these key terms: STATUS, CONDITION, CAPACITY, PERFORMANCE, STANDARDS, and NEEDS. These terms can be explained in terms of descriptors such as runway length, registered based aircraft, aircraft mix, number of operations, number of enplaned passengers, etc.

STATUS of the aviation system is a description of its state in terms of specific administrative, economic, geometric, physical, and operational characteristics. Status represents the actual or projected state of the aviation facilities. It relates to the ***role*** that each airport/heliport and aviation system component should perform in the total State aviation system.

The STATUS of aviation facilities in the SANS is defined through three facility classifications: (1) a classification system based on the National Plan Integrated Airport Systems (NPIAS); (2) a coding system developed by the FAA used to relate airport design criteria to the operational and physical characteristics of the airplanes intended to operate at an airport; and (3) a classification system that segregates the State's system of airports into three subsystems--Primary, Secondary, and Other Airports systems--based primarily on level of service an airport or heliport currently provides, or is intended to provide, to a community or region.

CONDITION represents the physical state of the aviation facilities. The condition of the aviation facilities measures the various levels of fitness of the aviation system, i.e., how that facility performs relative to a given status (role). Thus, condition indicates the level of physical

fitness of the aviation facilities. Condition is determined from surveys, existing data, and projections.

CAPACITY is used to designate the processing capability of an aviation facility over some period of time. Capacity is defined as the maximum physical capability of a runway system to process aircraft. It is expressed in this report as Annual Service Volume (ASV). As annual aircraft operations approach annual service volume, the average delay to each aircraft throughout the year may increase rapidly with relatively small increases in aircraft operations, thereby causing levels of service on the airfield to deteriorate. Capacity can be compared with the existing and forecast demand to ascertain whether improvements to increase Capacity will be needed.

PERFORMANCE is the measurement of the system against a standard. A Performance Measure is the "yardstick" utilized to assess how effectively the aviation system functions; for example, how aviation demand factors relate to airport facility factors, etc. Two primary measures of Performance are condition and capacity, explained above. They are primary, because they are essential for an aviation facility to accomplish its fundamental mission--the movement of people and goods--and other measures have been derived from or are related to these primary measures.

PERFORMANCE MEASURES will be used to select needed improvements, and to evaluate both the positive and negative impacts of improvements at aviation facilities.

PERFORMANCE LEVEL is defined as the actual or proposed Performance of the aviation system determined by specific values for a selected Performance measure. The performance levels are established to reflect attainable (not necessarily desirable) performance; for example, maintain only the existing facilities, maintain existing system performance level by providing for 15 percent added growth, etc.

STANDARDS are the minimum tolerable values of the performance measures established by an authority, such as FAA, ADOT, the Technical Advisory Committee, etc.

NEEDS are defined as specific improvements and the dollar amount required to achieve a given level of aviation system PERFORMANCE. Various levels of needs will be developed for the SANS 2000, reflecting differing levels of performance and investment.

## 2.3 DESIRED FEATURES FOR THE SANS 2000 METHODOLOGY

In selecting a methodology for use in the SANS 2000, a number of specific features are desired. Foremost, the selected methodology must provide a relatively simple procedure that can be used to evaluate the relationships between the performance of aviation system and capital investments made in various parts of the system. This will allow decision makers to realize the trade-offs involved in selecting one alternative over another.

Secondly, and related to the above feature, it is important that the selected methodology be able to define the state aviation system needs relative to stated system goals and objectives. Goal and objective statements are developed early in the process and are refined through an extensive public involvement process. It is important that the selected methodology be able to measure the

achievement of the various goals and objectives in order to ensure that the taxpayers wants and needs are being addressed.

Lastly, the selected methodology should allow for the synthesis of a large volume of data and information such as population, access measures, activity measures, environmental impacts, etc., into a manageable form for purposes of analysis.

## 2.4 CONCEPT SELECTED FOR THE SANS 2000

The concept selected for assessing the needs for the SANS 2000 is one based on the application of performance measures for evaluating alternative state aviation system needs scenarios. The primary elements of this concept include: (1) the identification of quantifiable measures needed to assess the existing performance of the Arizona aviation system; (2) the determination of the status, condition and performance of the existing system; (3) the development of a forecast of future system demand and available revenues; (4) the development of alternative needs scenarios to meet forecasts of demand; and (5) the determination of the cost of facilities and the performance of the system under each scenario. This concept provides an objective approach to a process which is largely subjective, through the development of quantifiable performance measures.

It is felt that the use of performance measures in Arizona aviation system planning will improve the process in several important ways:

- Performance measures will enable the State to quantify as well as qualify system plan objectives. Aviation system plan goal and objective statements tend to be general rather than specific. By using performance measures, the State will be able to sharpen and clearly define the precise meaning of each objective statement. On occasion, objective statements may have to be clarified, modified, or restated to make them useful for aviation system planning.

- Performance measures provide a quantitative link between system goal and objective statements and the performance of the aviation system. Performance measures provide for the scaling of how far each objective is achieved in an existing or proposed aviation system, or collectively, how far an existing or proposed aviation system meets all the system objectives.

- Performance measures are a beneficial tool for evaluation of alternative aviation systems as part of the initial assessment of needs and development or a major update for a state aviation system plan. Performance measures can be used to clearly quantify the trade-offs among a broad range of system plan alternative scenarios and to assist in narrowing the number of alternative scenarios to be studied in greater detail.

- Performance measures will enable the State to synthesize a large volume of data and information--population, access measures, activity measures, environmental impacts, etc. --into a manageable form for analyses purposes and for presentation to decision makers. One of the more difficult tasks of preparing a plan is to present to elected officials and government administrative staff the results of a comprehensive analysis in a simple,

straightforward, understandable manner. Performance measures can be used to clearly illustrate the interrelationships between the various objectives of a plan and the performance of the system.

- Performance measures can be combined into a single numerical value through weighting of the individual measures to reflect public policy, although weighting tends to mask important parts of the analysis and may, in effect, transfer to others choices which more properly should be made by the appropriate decision makers.

Once the aviation system needs have been identified and implemented, the performance measures can be used to improve the process for programming federal and state airport grant funds. System performance measures can be used to support budget requests to the state legislature by defining system needs and definitions relative to stated system goals and objectives.

All of the publicly-funded transportation modes--highways, transit, and aviation--are in need of increased funding. Budget requests need to be supported by return-on-investment analysis which is both comprehensive and easily understood. Aviation system performance measures can be used to strengthen agency budget requests in Arizona.

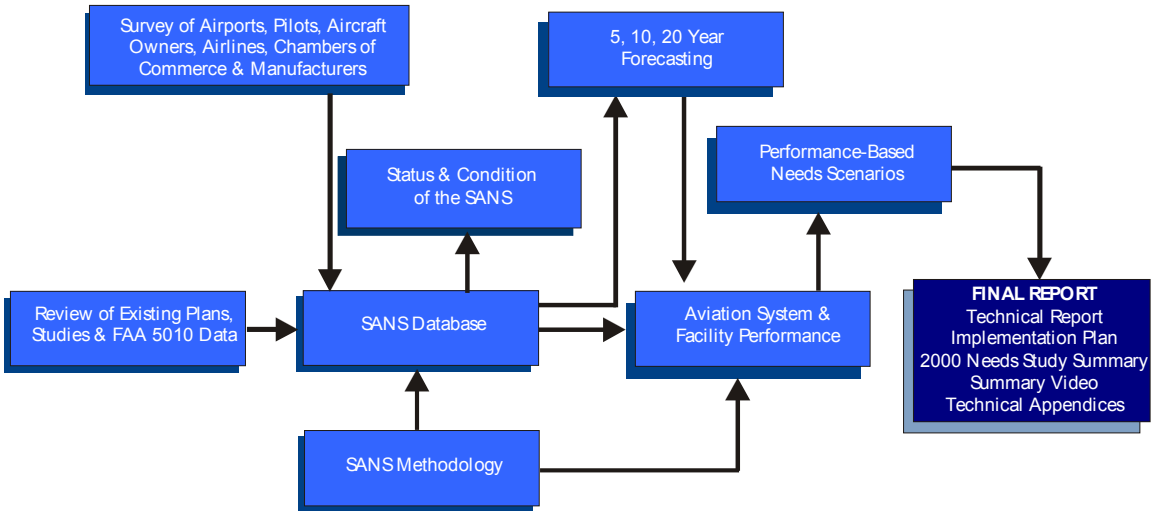
**Description of Methodology**

A step-by-step description of the methodology to be employed in performing the 2000 Needs Study is relatively straightforward conceptually and in application. The decision maker is the primary user of the analysis produced.

Shown in Exhibit 2-1, the first step of the process is to formulate the goals, objectives, and priorities that represent the desired set of conditions for the State system of airports. The goals and objectives were formed through a public input process that utilized comments of the Planning Advisory Committee (PAC). From the goals and objectives, performance measures are identified and defined.

The next major step in the process is to create a data base to provide the information needed to determine the status and condition of the existing system. The status of the system relates to the role that each aviation facility performs in the total State aviation system. It is based on specific administrative, economic, geometric, physical, and operational characteristics. The condition represents the physical state of the aviation system; that is, how the facility performs relative to a given status. Creation of the data base is an on-going process and will continue throughout the course of the SANS study as new information is received from airport sponsors.

**EXHIBIT 2-1:** ***SANS Methodology Flow Chart***




Another important aspect of the data base was to generate enough information to perform a forecast of aviation activity and system capacity for the next five-, ten-, and twenty-year time frames. The forecast of statewide aviation activity was used to determine future demand on the statewide system and be central to the development of the future scenarios.

The performance-based needs scenarios were the focus of the study. Needs scenarios were developed to evaluate the various alternative future aviation system development strategies. They were matched against the performance measures that reflected the desired condition and level of service the state aviation system should provide. Three alternative development strategies were considered. By comparing each system development scenario to the performance measures, State decision makers can determine the level of performance that each scenario will provide, as well as the associated costs of that scenario.

Alternative development scenarios were based on various ways of achieving a high level of systemwide performance, such as accommodating future demand and provision of rural health care services, given limited financial resources. Comparing investment strategies with performance measures clearly shows where systemwide performance trade-offs will occur. Since the weighting of performance measures is always subjective, no relative weights were considered. All the performance measures taken together reflect the profile of each scenario.

### Constraints, Assumptions, and Limitations

As with every methodology, there are some constraints and limitations to the use of performance measures, as well as some general assumptions that must be noted. A discussion of these follows.

Perhaps the key assumption of the methodology is that overall system performance should take precedence over the individual facilities. System performance measures are not particularly sensitive, on an annual basis, to programming decisions involving individual airport projects. The definition of programming is the matching of available funds to satisfy the needs of a given time period. The reason for this is that improvements in a single airport or even a small number of airports will have only a small impact on the performance of the aviation system for an entire state. Viewed over a longer period of time, for example, a five-year period, performance measures will prove beneficial in evaluating alternative programming policies and for evaluating the improvements in system performance anticipated from a five-year capital improvement program.

Additionally, system performance measures are more sensitive to needs to provide increased access and to forecast demand than they are to deficiencies in the structural integrity of existing airports. As the proportion of reconstruction and standards type projects decreases, the sensitivity of the performance measures to programming decisions will increase. The SANS is a macro-level analysis and leads to system wide needs. Priority programming, on the other hand, is a micro-level evaluation and leads to specific project improvements.

The performance measure components for each airport being considered for a grant can aid in determining the relative contribution that each airport makes to the performance of the total aviation system. Performance measures selected for assessing system needs are not sufficient criteria for priority programming decisions related to specific airport improvement projects, as many other factors must be considered. Performance measures may, however, provide a basis for first cut in selective airport projects on the basis of their relative contribution to the State's aviation system.

## 2.5 PERFORMANCE CRITERIA AND MEASURES

In the previous section, it was concluded that the use of performance measures can improve the aviation system planning process by quantifying as well as qualifying system objectives, linking system objectives and system performance, clarifying trade-offs among system alternatives, and by synthesizing information for decision makers. This section will provide a more detailed description and role of performance measures, apply performance measures and standards to the study objectives, explain the use of future scenarios, and discuss the determination of minimum acceptable levels of performance.

### Role of Performance Measures

Goal and objective statements are used to define the desired condition to be achieved in the development and operation of the Arizona aviation system. They are broadly stated in general terms. For example, a primary goal of the SANS is to provide for the timely development of

aviation facilities adequate to meet the needs and economic goals of the state. An objective related to the above goal is to facilitate the provision of convenient commercial air service to both urban and rural communities. A performance measure is used to clarify and define the meaning of the goal or objective statement and provide for a scaling of how well the goal or objective is attained in any defined system.

As an example, in the above objective statement, the definition of "convenient" could be defined as 60 minutes driving time; the term "commercial air service" could be defined as scheduled passenger service operating a minimum of two flights a day, five days a week; and "community" could be defined as an incorporated town with a minimum population of 5,000. By defining these terms, the objective statement now lends itself to quantification. Thus, the measure of performance related to the provision of convenient commercial air service would be: the percentage of communities within the state, with a minimum population of 5,000, that are within 60 minutes driving time of an airport that provides regularly scheduled passenger service.

The performance measure now can be used to assess the existing system in terms of the provision of commercial service, measure future system performance under varying conditions, and provide a way of evaluating among system plan alternatives. Also, once an alternative has been selected and implementation initiated, the process of that alternative can be tracked.

**Performance Measures**

To adequately assess the system, three general categories of performance measures were developed: Facility, Service Level, and Economic Measures. The first relates to the performance of the individual facilities making up the system, the second to the level of service provided by those facilities, and the third to the efficiency of the system and return on investment.

Facility Performance

The facility performance measures are general measures designed to assess the condition, or fitness, of the region's existing airport infrastructure. The two primary measures of facility performance are condition and capacity. They are primary because they are essential for an aviation facility to function in a safe and efficient manner. The performance criteria listed below were designed to reflect the current and desired condition and performance of the existing and future aviation infrastructure relative to basic recognized standards.

**Facility Performance Measures**

1. The extent to which system airports meet FAA and ADOT Transportation Board minimum aviation development and planning standards.

2. The number of airports with an annual demand less than 60 percent of runway annual service volume.

3. The number of airports experiencing delay to aircraft operations: the maximum and average delay in minutes an aircraft experiences due to airside congestion.

4. The number of airports that generate INM noise contours greater than 65 DNL that extend off airport property.

5. The number of system airports without adequate utilities (electricity, telephone, water, sewer, and gas).

6. The number of airports with no close-in obstructions (within the 200 feet primary surface) and where all FAR Part 77 approach obstructions are marked (not including trees and roads).

7. The number of total airports in the state with no or minimal shared airspace and/or restrictions under visual/instrument flight rules.

Service Level Performance

Service level performance measures, in relation to facility performance measures, were designed to measure the adequacy of the system in fulfilling its fundamental mission of the movement of people and goods. Listed below are performance measures that measure the provision of aviation services to the residents of the State of Arizona in relation to some general national standards.

**Service Level Performance Measures**

1. Percent of communities in the State with a population greater than 5,000 within 60 minutes of a commercial service airport.

2. Percent of communities in the State with a population greater than 1,000 within 30 minutes of a general aviation airport.

3. Percent of communities in the State with a population greater than 15,000 within 30 minutes of a general aviation airport that can accommodate large general aviation aircraft (ARC B-II) and has Instrument Meteorological Conditions (IMC) capability.

4. Percent of hospitals in the State within 30 minutes of a general aviation airport with Instrument Meteorological Conditions (IMC) capability, with on-site weather reporting, and jet fuel availability.

5. The number of major recreational areas in the state within 30 minutes of a general aviation airport.

Economic Performance

**Economic Performance Measures**

1. The dollar cost of aircraft delay to Arizona airport system users.

2. Dollars of direct and indirect economic impact on the state from aviation.

3. The cost ratio of annual aviation infrastructure to total number of statewide annual enplaned passengers and annual aircraft operations.

4. The total dollar cost from aircraft delays associated with airspace congestion.

## 2.6 DEVELOPMENT SCENARIOS

To facilitate the understanding and appreciation of the financial needs of the State's aviation system, it is important to assess the system performance changes that the investment of these funds may induce. Once a performance-based needs model is available, a theoretically infinite number of scenarios can be developed. For a given level of financial investment it is possible to achieve a given performance level with a range of funding levels. There are operations research tools (e.g., dynamic programming, linear programming, simulation) available, which can help planners and decision makers determine the optimal investment strategy for achieving a given performance level, and vice versa. That effort is, however, beyond the scope of the current study.

In this project, three scenarios were developed. It should be noted that the level of investment and system performance gradually improves from Scenario A to Scenario C.

Each scenario will be evaluated by forecasting demand of statewide aviation activity over the next five-, ten-, and twenty-year periods and applying the performance measures identified in the previous section to determine the performance level of the state aviation system.

This method will allow decision makers to clarify trade-offs among system funding commitments through the comparison of performance levels of each system alternative for each of the three scenarios. Comparison of performance levels for each scenario will also link levels of funding to the achievement of public policy as represented by the State's goals and objectives for the Arizona aviation system, inherent in the development of the performance measures.

**Scenario A - Existing Investment:** This scenario was designed to explore a possible situation/state in which the existing funding level (in current dollars) will be assumed to remain unchanged over the next five-, ten-, and twenty-year periods. The goal was to examine the types of improvements that can be done in the circumstances in which the funding for maintenance and construction of aviation facilities does not keep up with the increasing demand. In this scenario, status, condition, and performance of the system at the fixed level of funding are evaluated.

**Scenario B - Existing Performance (Facility Preservation):** This scenario was designed to explore a possible situation/state in which the existing system performance level will remain unchanged. The goal is to estimate a level of funding which can help the state aviation system keep up with the increasing demand in the future. A funding level for each of the five-, ten-, and twenty-year periods is estimated. In this scenario, the financial needs to maintain the existing system status, condition, and performance are estimated.

**Scenario C - Increased Performance (Facility Upgrade):** The third scenario examines a possible situation/state in which all existing public-use airports are brought up to meet minimum State airport development standards, existing airports are expanded to meet forecast demand, and new airports are constructed to meet access or capacity deficiencies. This is essentially an unconstrained growth scenario and determines the costs of expanding

and increasing the efficiency of the existing system to meet the expected growth in future State aviation activity.

For each of the above scenarios, it is possible to have thousands of strategies to achieve the stated goals. However, we are only identifying one of several situations/states for each of the three scenarios in this study. The performance-based needs model developed in this study would be capable of exploring other situations/states and additional scenarios as may be desired by the state planners and decision makers. The model is flexible enough to allow modification of decision variables based on input from public or alternative forecasts.

## 2.7 SUMMARY

The concept for assessing the needs for the SANS 2000 is one based on the use of performance measures for evaluating alternative state aviation needs scenarios. The primary elements of this system include (1) the identification of quantifiable measures needed to define the performance of the state aviation system; (2) the determination of the status, condition, and performance of the existing system; (3) the development of a forecast of future system demand and available revenues; (4) the development of alternative needs scenarios to meet forecast of demand; (5) the determination of the cost of facilities and the performance of the system under each scenario; and (6) the selection of a recommended course of action.